

EXHIBIT 15

17

where the roundtripdelay is the time equal to the round trip from when a retransmission message is transmitted to when the retransmitted packet is received and the data rate is the data rate of the connection that is transferring the packets.

For ITU-T G.993.2 VDSL2 this can be computed using the VDSL2 profile parameters as:

Minimum RX memory(octets)=(DS+US Interleaving Delay in octets)+(US+DS alpha/beta delay without interleaving)*(Bidirectional Net data rate)= MAXDLEYOCTET+(4ms)*MBDC,

where MAXDELAYOCTET and MBDC are as specified in the ITU-T G.993.2 VDSL2 profiles.

TABLE 1

Minimum TX or RX memory requirements for VDSL2				
VDSL2 PROFILE	8a, 8b, 8c, 8d	12a, 12b	17a	30a
TX or RX memory requirements (octets) = MAXDLEYOCTET + .002MBDC	90,536	99,536	123,304	231,072

The estimates in Table 1 assume that all the entire MAXDELAYOCTET and MBDC are used for the transfer of the packet stream, i.e., the reverse channel has a very low data rate and no interleaving.

Some xDSL standards specify minimum storage, i.e., memory, requirements for interleaving of RS codewords. Interleaving with RS coding is an effective way of correcting channel errors due to, for example, impulse noise. For example, VDSL2 requires support of an aggregate bidirectional interleaver and de-interleaver memory of 65 Kbytes for the 8a VDSL2 profile. This corresponds to storage requirement of approximately 32 Kbytes in a single transceiver.

Sharing of Memory Between the Retransmission Function and One or More of the Interleaving/Deinterleaving/RS Coding/RS Decoding Functions

From Table 1, it is apparent that the memory requirements to support the retransmission protocol may be more than double the storage requirements of a single transceiver. Additionally, the retransmission protocol provides a different method for correcting channel errors due to, for example, impulse noise.

Moreover, interleaving and RS coding methods and retransmission protocols provide different advantages with respect to error correction capabilities, latency, buffering requirements, and the like. For example, under certain configuration and noise conditions the interleaving/RS coding provides error correction/coding gain with less delay and overhead than the retransmission protocol (for packets that can be retransmitted). While under other conditions the retransmission protocol will provide better error correction with less delay and overhead than the interleaving/RS coding.

In some cases, a first portion of the memory can be used for one function and a second portion of the memory for some other function. For example, if the configuration and noise conditions are such that the interleaving/RS coding would not provide good error correction/coding gain, then all the available memory could be used for the retransmission function and none allocated to the interleaving/deinterleaving/RS coding/RS decoding functionality, e.g., the interleaving/deinterleaving could be disabled.

Likewise, if the configuration and noise conditions are such that the retransmission protocol would not provide good error correction/coding gain, then all the available memory could be used for the interleaving/deinterleaving/RS coding/

18

RS decoding functionality and no memory would be used for the retransmission function, e.g., the retransmission function would be disabled.

Alternatively, or addition, both methods could be used because both have their advantages, with the system, e.g., the memory management module 370, being able to dynamically allocate a first portion of the memory 250/350 to the interleaving/deinterleaving/RS coding/RS decoding functionality and a second portion of the memory to the retransmission functionality. For example, 40% of the memory could be allocated to the interleaving/deinterleaving/RS coding/RS decoding functionality with the remaining 60% allocated to the retransmission of functionality. However, it should be appreciated, that in general, the memory can be divided, i.e., shared, in any manner.

The sharing of memory between the retransmission function and the interleaving/deinterleaving/RS coding/RS decoding functions is not restricted to retransmission protocols described in other embodiments that utilize QOS metrics to determine which packets should be retransmitted. In other words, the sharing of memory between the retransmission function and the interleaving/deinterleaving/RS coding/RS decoding functions can be utilized for retransmission systems where all errored packets are retransmitted, i.e., there is no QOS identifier in the retransmission protocol. For example, the FEC/interleaving could be used to meet the INPmin requirement specifically targeting the impulse noise that occurs frequently (e.g., on the order of minutes or seconds) but is short in duration and can therefore be corrected by the FEC/interleaving. For example, the retransmission protocol can be used to correct infrequent errors (on the order of hours) that are long in duration and would not be correctable by the FEC/interleaving. As another example, the FEC/interleaving function may be used in combination with the retransmission function because it is well known that FEC with minimal interleaving provides a 1 dB to 3 dB coding gain when used with a trellis code (as is often the case in xDSL systems). This means that even when the majority of the shared memory is allocated to a retransmission function to address channel noise (such as impulse noise), a smaller amount of memory may be allocated to the FEC/interleaving function for the coding gain advantage.

Associated with the ability to allocate or partition memory between one or more of the interleaving/deinterleaving/RS coding/RS decoding functionality and retransmission functionality, is the ability to exchange information between transceivers on how to establish this allocation. For example, the transmitting modem may send a message to the receiving modem indicating how much of the available memory is to be allocated to one or more of the interleaving/deinterleaving/RS coding/RS decoding functionality and how much memory is to be allocated to the retransmission functionality. For example, if the receiving modem contains 100 kBytes of available memory, the transmitting modem could send a message to the receiving modem indicating that 25 kBytes should be allocated to RS coding functionality and 75 kBytes should be allocated to the retransmission functionality. Since the receiving modem generally determines the interleaving/RS coding parameters that are used, the receiving modem could use this information to select parameters, e.g., interleaver depth and codeword size, that would result in an interleaving memory requirement that is no more than the amount indicated in the message.

Alternatively, or addition, the receiving modem can send a message to the transmitting modem indicating how much of the available memory is to be allocated to one or more of the